

Is the functional outcome of modular bipolar better than Monoblock bipolar hemiarthroplasty in the treatment of elderly neck of femur fracture patients- A retrospective cohort study of 5 years follow-up.

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Introduction

Neck of femur fracture is the most common fracture in geriatric low demand patients. Osteoporosis and increased tendency to fall from standing height due to instability from various medical comorbidities contributes to this ever-increasing problem. Hemiarthroplasty is the gold standard treatment for displaced neck-of-femur fractures Though various implants are available in the market for performing hemiarthroplasty surgery, most commonly used ones are Monoblock bipolar implants till recent past. But nowadays there is trend toward using modular hemiarthroplasty implants. But no consensus exists regarding the indications for different implant types. This variation is reflected by the global survey reported by Bhandari et al.¹ and by the significant variance in the Australian and European National Joint Replacement

Registry². Despite this variability, the use of the Monoblock implant usage has consistently decreased over the last few years.

Modular hemiarthroplasty design provides the surgeon with multiple options to restore leg length and femoral offset with a range of stem sizes, femoral offset options, and head sizes that allow for minor adjustments during surgery^{3,4}. Like total hip replacement techniques, it is expected that reconstruction of anatomic hip architecture is associated with positive clinical outcomes in patients undergoing hemiarthroplasty for neck of femur fractures^{5,6}

also. Monoblock bipolar stems are mostly fixed with bone cement whereas in modular hemiarthroplasty system, uncemented stems are mostly used which would reduce problems with bone cement related complications. On the flip side, the cost of modular implants

are six times higher than Monoblock system which would play a major role in decision making in rural context.

Although there is some literature support for imported uncemented femoral stems used in modular hemiarthroplasty like Corail stems indigenous HA coated uncemented stems from India have very few literatures evidence. we intend to use indigenous uncemented HA (hydroxyapatite) coated uncemented stems (Biotech India private limited) because of its cost effectiveness and compared it to good old cemented Monoblock bipolar stems (Sharma Orthopaedics India private limited) for its longevity and complications.

On this background we conducted this study that examined hemiarthroplasties performed for neck of femur fractures between 2016 and 2021. The primary objective of this study was to compare functional outcome of modular bipolar hemiarthroplasty using indigenous HA coated stems and Monoblock bipolar hemiarthroplasty. And their mortality rate and revision rate. Our hypothesis was that modular hemiarthroplasty would have better functional outcome as it provides superior hip architecture restoration.

Methods

We identified patients who underwent hemiarthroplasty between January 2016 and December 2021 from our medical records data in our hospital, India. Only cases of primary hip hemiarthroplasty for traumatic NOF fractures with age greater than 55 were included. Any revision cases, pathological fractures, or those with a previous femoral fracture on the side of injury were excluded from the study.

There were 52 cases of Monoblock group (operated 2016 to 2019) identified out of which 2 cases were expired two years after surgery due to age related

comorbidities. Ten Monoblock cases did not come for regular follow-up and also not reachable. Hence remaining 40 Monoblock hemiarthroplasty cases were included in the study. 24 modular hemiarthroplasty patients operated from 2018 onwards were also included in the study.

The experience of the operating surgeons varied from associate professor to professor levels. Monoblock or modular bipolar Implant choice was made after consulting with patient. The standard anterolateral approach (Hardinge) was used in all cases.

Surgical technique

Usually patients were given spinal anaesthesia. Patient was positioned in lateral position. Incision of skin of about 10cm was made along midline of femur shaft and extending 3 to 4cm proximal to greater trochanter. Subcutaneous tissue and deep fascia were cut along the line of skin incision. Conjoint tendon of gluteus Medius and vastus lateralis were incised at anterior 1/3 and posterior 2/3 junction and anterior aspect of vastus lateralis was elevated from greater trochanter along with hip capsule while the leg is externally rotated and fracture neck of femur was exposed. Preliminary neck cut was made to make room for femoral head removal with cock screw and c clamp. Native femoral head size was measured and then leg is kept in flexion and adduction and external rotation to expose proximal end of femoral canal. Femoral canal preparation was done using box cut first and then canal finder and finally broaches to create enough space for cemented stem in valgus position. Thorough wound wash was given and femoral canal was cemented by second generation technique and bipolar stem was fixed in appropriate anteversion of 10 to 15 degrees. Once the cement is set, hip is reduced by traction and internal rotation and hip

stability and leg length were checked. Conjoint tendon with hip capsule was sutured onto the greater trochanter and wound closed in layers.

In case of uncemented modular bipolar prosthesis, some extra points to be taken care is, to create snug fit femoral space for uncemented stem and after trial with appropriately sized femoral head fixed onto the trial femoral stem, original prosthesis was fixed and hip was reduced and hip stability and leg length were rechecked.

Results

The demographic distribution of patients was shown in the table 1. The results of the study was analysed using spss software version 16. Majority of the patients (45.8%) in modular group were between 55 to 60 years and in case of Monoblock group, most patients (52.6%) were in between 60 to 70 years. Female patients were predominant in both modular and Monoblock groups. Right and left side cases were equally distributed in modular group whereas right side was predominant in Monoblock group.

The mean Harris hip score for modular and Monoblock groups were 72 and 71 respectively. The standard deviation of modular and Monoblock groups were 6 and 13.9 respectively. Independent T test found no statistical significance with p value of 0.818 between the two groups regarding Harris hip score functional assessment. Chi square test found no statistical significance between different grades of Harris hip score with modular and Monoblock groups but most of modular patients (62%) were in fair group and most of Monoblock patients (47.4%) were in poor group.

Association between demographic variables age, gender and right and left side of surgery with harries hip score found no significant with modular patients. Similarly no significance was found with gender and side of surgery

in Monoblock patients also but age was associated with statistical significance in Monoblock patients. Mono block patients younger than 70 years had fair harries hip score rather poor hip score was found with older Monoblock patients (> 70 years).

Discussion

Hemiarthroplasty is the most common surgery for displaced fracture neck of femur in elderly people worldwide. Widely used implants are monoblack and modular bipolar implants in India. In our institute we started using cost effective indigenous uncemented modular bipolar implants instead of imported ones and compared its results regarding surgical difficulty, complications and longevity of implant with that of good old cemented Monoblock bipolar implants.

Dislocation rates are very less in bipolar hemiarthroplasty as reported by various papers worldwide. Rafel et al ⁷ found dislocation rate of 1.1%,1.5% and 2.1% at 1 year, 5 years and 10 years respectively in bipolar hemiarthroplasty. Gill et al ⁸ found 1.4% dislocation rate in bipolar hemiarthroplasty series. In our series, dislocation was found in one out of 40 cases (2.5%) in Monoblock bipolar hemiarthroplasty series which happened one month postoperatively and none in 24 modular bipolar hemiarthroplasty cases. The dislocated hip was reduced by open surgery. We attribute the fact that low rate of dislocations occurred due to greater stability of the bipolar prosthesis.

Luo et al ⁹ reported that cemented prosthesis provided better functional and radiographic results. Viberg et al ¹⁰ stated that reoperation rate and hazard ratio were lower for cemented hemiarthroplasty than for internal fixation, uncemented and uncemented hydroxyapatite-coated hemiarthroplasty in 75+ year-old femoral neck fracture patients. Krishnan et al ¹¹ reported uncemented modular

bipolar provided better functional results and Bell et al¹² reported fewer complications with uncemented Corail stem. Heng khan et al¹³ compared modular versus Monoblock bipolar implants and concluded that Monoblock implants under-restored femoral offset, but not leg length, in neck of femur hemiarthroplasties and there was no significant difference in length of stay in hospital, 30-day mortality, discharge destination, or revision rates between both implant groups. In our series also both cemented Monoblock and uncemented modular bipolar cases resulted in similar functional outcome over a period of 5 years.

Emery¹⁴ in a randomized prospective trial found the incidence of postoperative complications, early mortality, operating time, and blood loss were not significantly different for cemented and uncemented prosthesis. In the Krishnan et al¹¹ study, however, there was no statistically significant difference in operating time but blood loss was lower in the uncemented group. There was less operating time and equal blood loss in uncemented modular bipolar than cemented Monoblock bipolar surgeries in the present study.

Bell et al¹² found no difference in mortality rate between uncemented Corail stem and cemented Exeter stems used hemiarthroplasty patients. There is 6 percent mortality rate in Monoblock group (death occurred 2 years after index surgery) due to age related comorbidities compared to none in modular group probably because Monoblock patients were relatively older than modular patients at the time of surgery (mean age 72 vs 64 respectively) in the present study.

All the patients in this study were elderly and all femurs were osteoporotic. Thus, careful placement of the Hohman retractor on the proximal femur and gentle

femur broaching and stem insertion was important to avoid intraoperative fractures. We experienced two cases (8%) of intraoperative periprosthetic calcar fracture in uncemented modular bipolar surgery which was managed with circlage wiring and delayed weight bearing but no case of intraoperative femur fracture occurred in cemented monoblock bipolar surgery. Chandran¹⁵ reported a rate of 7.4% for intraoperative periprosthetic fractures for uncemented bipolar prosthesis, these occurred while attempting to secure a tight fitting uncemented stem.

Emery¹⁴ found use of uncemented stems was associated with more hip pain and greater need for walking aids than cemented stems (when using Monk Duoplet Bipolar prosthesis with Thompson and Austin Moore stem). Overgaard¹⁶ reported that 4 of 62 patients, a relatively small proportion, complained of pain with weight-bearing 6 years after uncemented bipolar hemiarthroplasty. One case of persistent midhigh pain was present in a case of modular bipolar prosthesis with no loosening and hence managed medically in our series. In Krishnan et al¹¹, four cases of acetabular erosion were encountered (two in each group), which is comparable to rates reported by Devas et al¹⁷ and one case of stem loosening in the cemented group due to technical error. In our series no acetabular erosion and stem loosening occurred so far in either of the groups.

The longevity of the indigenous monoblock and modular implants used in our study were found to be good at 5 years follow up with no implant failure, minimal subsidence and no loosening of stem.

There is an advantage of restoring leg length and offset to near normal range in modular bipolar prosthesis but clinically no difference in functional score was found in both the case series. But the cost of monoblock bipolar

prosthesis is six times higher compared to modular bipolar prosthesis in the background where we mostly operate on low-income patients from villages and municipal areas.

Despite the modular system's advantages, there is also risk for metal debris associated with the additional interface between bipolar head and neck, leading to wear and early failure which is termed "trunnions". According to the current systematic review, Gross Trunnion Failure was typically detected 4 to 14 years after total hip arthroplasty¹⁸.but it may happen little latter in modular bipolar hemiarthroplasty, because as suggested by Del Balso et al ¹⁹, torque force at the head and neck junction is less in bipolar hemiarthroplasty due to added articulation than total hip arthroplasty .The risk of trunnionosis is nil with Monoblock bipolar compared to modular bipolar in long term follow-up and so survival of the Monoblock bipolar implant would be better .

The present study has some limitations that require consideration. First, it was a retrospective case-controlled study rather than a prospective randomized controlled study. Second, femoral neck fractures were treated with indigenous Monoblock and modular bipolar stems. The longevity of these implants need to be observed in longer period of 10 to 15 years. Third, the sample is small but reasonable considering this is one of the few studies on indigenous bipolar implants.

Conclusion

Overall our study found no statistical significance of functional outcome between Monoblock and modular bipolar patients. On intragroup analysis, modular bipolar patients were more in fair functional grade than Monoblock bipolar patients. Restoration of native hip architecture is better with modular bipolar hemiarthroplasty but at higher implant cost. The longevity of

indigenous hydroxyapatite coated modular bipolar implant was comparable to good old Monoblock bipolar implant at 5 years follow up.

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Figure 1: Monoblock bipolar implant



Figure 2: orthotech hydroxyapatite coated modular bipolar stem



Figure 3: Cemented Monoblock bipolar hemiarthroplasty left hip



Figure 4: Hydroxyapatite coated uncemented bipolar hemiarthroplasty right hip (circlage wiring done for intra operative calcar fracture)

Table 1: Distribution of Demographic variables of Monoblock and modular bipolar patients

Demographic variables	Monoblock (n = 24)	Modular (n = 40)
	No. (%)	No. (%)
Age Group	Mean (SD) 64.5	Mean (SD)
a. ≤60	(9.9)	72.0 (6.0)
b. 61-70	11 (45.8)	4 (10.5)
c. >70	8 (33.3)	21 (52.6)
	5 (20.8)	15 (36.8)
Gender		
a. Male	8 (33.3)	10 (26.3)
b. Female	16 (66.7)	30 (73.7)
Side		
a. Right	12 (50.0)	24 (57.9)
b. Left	12 (50.0)	16(42.1)

Table 2: Comparison of Harris Hip Score between two groups

	Modular Bipolar n=24	Monoblock Bipolar n = 40	Independent t – test value and p - value
	Mean (SD)	Mean (SD)	
Harris Hip score	72.04 (6.0)	71.32 (13.9)	t = 0.231, p= 0.818 (Not significant)

Table 3: Comparison of Harris Hip Score between two groups grade wise

Level of Harris Hip	Modular Bipolar n=24	Monoblock Bipolar n = 40	Chi-square test and p values
	No. (%)	No. (%)	
Poor (< 70)	7 (29.2)	19 (47.4)	$\chi^2= 6.422$ d. f =3 p = 0.093 (Not Significant)
Fair (70 -79)	15 (62.5)	11(26.3)	
Good (80 – 89)	2 (8.3)	8(21.1)	
Excellent (\geq 90)	0 (0.0)	2(5.3)	
Total	24	40	

Table 4: Association between Harris Hip Score and Demographic variables for Modular bipolar implant

Demographic variables	Modular Bipolar n=24			F and t values and p value
	Number	Mean	SD	
Age Group				F = 2.131 P=0.144 (Not significant)
a. ≤ 60	11	74.36	4.36	
b. 61-70	8	68.87	5.72	
c. >70	5	72.00	8.18	
Gender				t = 1.347 P=0.192
a. Male	8	69.75	5.80	

b. Female	16	73.19	5.93	(Not significant)
Side				t = 0.167 P=0.869 (Not significant)
a. Right	12	72.25	5.71	
b. Left	12	71.83	6.52	

Table 5: Association between Harris Hip Score and Demographic variables for Monoblock Bipolar

Demographic variables	Monoblock Bipolar n=40			F and t values and p value
	Number	Mean	SD	
Age Group				F = 3.82 P=0.004 (Significant at p <0.05 level)
a. ≤ 60	4	76.60	1.41	
b. 61-70	21	77.40	10.02	
c. >70	15	61.29	15.47	
Gender				t = 0.162 P=0.874 (Not significant)
a. Male	10	72.20	12.07	
b. Female	30	71.00	14.83	
Side				t = 0.244 P=0.810 (Not significant)
a. Right	24	70.64	10.56	
b. Left	16	72.25	18.26	